Available online at www.sciencedirect.com

ScienceDirect

Electronic Notes in DISCRETE MATHEMATICS

Electronic Notes in Discrete Mathematics 66 (2018) 143–150 www.elsevier.com/locate/endm

# A modified variable neighborhood search hybridized with genetic algorithm for vehicle routing problems with cross-docking

Ali Baniamerian [1], Mahdi Bashiri [2], Fahime Zabihi [3]

*Department of Industrial Engineering, Shahed University, Tehran, Iran*

**Abstract**

This paper addresses a novel hybrid metaheuristic combining the Genetic algorithm (GA) and Modified Variable Neighborhood Search (MVNS) for the vehicle routing problem with cross-docking. In this paper, we propose four shaking and two neighbourhood structures in a modified version of the VNS. The basic VNS is an efficient and successful method to solve combinatorial optimization problems, but sometimes applying it in problems with large solution space is time consuming, so to avoid expending too much computational time, a multi-part solution representation with a new searching approach is proposed and some modifications are applied to the VNS and hybridized with the GA. To show the effectiveness of the proposed hybridized approach, a comparative study is performed for existing vehicle routing problem with cross docking test problems.

*Keywords:* Modified variable neighborhood search, Genetic algorithm, Hybrid algorithm, Cross docking, Vehicle routing.

[1] Email: a.baniamerian@shahed.ac.ir
[2] Email: bashiri@shahed.ac.ir
[3] Email: f.zabihi@shahed.ac.ir

https://doi.org/10.1016/j.endm.2018.03.019

# 1 Introduction

This paper has an efficient approach to solve vehicle routing problems with cross docking and propose a novel hybrid metaheuristic to solve large-size problems. The cross docking strategy is one of the most important distribution strategies in logistics which todays is widely used by companies to reduce inventory level and increase customer satisfaction in the supply chain [2]. Integrating the vehicle routing problem with cross-docking system as an important decision can significantly increase the capability of designing an efficient system in this kind of warehousing.In this paper, a metaheuristic algorithm consisting of a hybrid GA with modified VNS is developed to solve vehicle routing problems with cross docking. The results show efficiency of the proposed hybrid algorithm comparing with the GA and VNS algorithms.

The paper structure is organized as follows: In section 2, a brief review on the literature is presented. Problem description is presented in the section 3. Section 4,5 includes the proposed metaheuristic algorithm. Section 6 reports the results of computational experiments. Finally, the conclusion is given in section 7.

# 2 Literature review

The vehicle routing problem with cross-docking (VRPCD) was first introduced by Lee et al. [3] to minimize the transportation and fixed costs of used vehicles. A Tabu search algorithm was used to solve the problem. Liao et al. [4] proposed another Tabu search algorithm to solve the same problem in better computational time and with less used trucks. Wen et al. [6] considered a pickup and delivery problem with consolidation which orders are consolidated at a cross dock after pickup phase then immediately are delivered to customers. Moghadam et al. [5] proposed a VRPCD with split deliveries. Baniamerian et al. [1] discussed customer satisfaction and proposed a two phase genetic algorithm to the problem. Although many characteristics have been considered in the integration of VRP and cross-docking but because of the NP-hardness of the problems, designing a general solution approach which can handle different kinds of problems in less computational time and achieve better solutions is necessary. So, in this paper a multi-part solution representation is introduced for the vehicle routing problem with cross docking and a hybrid metaheuristic is proposed to solve large-size problems in a reasonable computational time.